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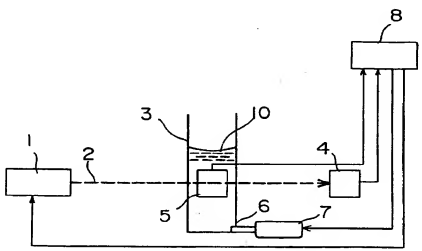
## (54) Method and apparatus for measuring concentration of a solution

(57) An object of the present invention is provide a means capable of enlarging the measurable concentration range of a specific component in a solution to be detected, and further measuring a precise solution concentration with ease even when there occur inhibitors such as contamination of a sample cell, turbidity of the solution to be detected, and suspending particles. For achieving this object, the transmitted light intensities and/or the scattered light intensities of the solution to be detected before and after mixing a reagent for changing the optical characteristics of the solution to be detected attributed to the specific component are measured to obtain the concentration of the specific component in the solution to be detected from these measured values. Further, while obtaining the protein concentration by the foregoing method, the optical rotation of the solution to be detected is measured before the mixing of the reagent, thereby to determine the concentrations of the protein and other optical active substances than the protein.

FIG. 1

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## Description

### BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to a method and an apparatus for measuring the concentration of a solute, for example, a concentration of protein and a concentration of an optical active substance dissolved in a solution to be detected.

**[0002]** Examples of a conventional solution concentration measuring apparatus include a spectroscope and a liquid chromatography. Whereas, as a urinalysis apparatus, there has been an apparatus whereby a test paper impregnated with a reagent or the like is dipped in a urine, and a color reaction thereof is observed by means of a spectroscope or the like to detect the components of the urine.

**[0003]** The test papers herein used are prepared according to the kind of respective inspection items such as glucose and protein.

**[0004]** However, with the forgoing method, there has presented a problem of an enlargement in size of the apparatus. Further, there has also presented another problem as follows. The concentration range measurable is restricted, so that a solution to be detected having a concentration beyond the restricted range is required to be diluted for a test, resulting in a complicated process. Still further, there have been some cases where accurate measurement results cannot be obtained under the influence of the turbidity of the solution to be detected itself, and the contamination of an optical window. Moreover, there has been a still further problem that the presence of various particles, bubbles and the like suspending in the solution to be detected within an optical path for a light, which is used for the measurement, causes a malfunction.

**[0005]** It is therefore an object of the present invention to provide an apparatus for measuring concentration of solution with high reliability, compactness in size, and easy maintenance and control thereof, and a measuring method enabling the apparatus design thereof, thereby solving the foregoing problems. Further, it is another object of the present invention to provide a means enabling easy and high precision urinalysis.

### BRIEF SUMMARY OF THE INVENTION

**[0006]** For solving the foregoing problems, the present invention provides a method for measuring a concentration of specific component in a solution to be detected, the method comprising the steps of: measuring a transmitted light intensities and/or a scattered light intensities of the solution to be detected before and after being mixed with a reagent for changing the optical characteristics of the solution to be detected, attributed to the specific component; and determining the concentration of the specific component in the solution to be detected based on these measured values.

**[0007]** In this case, it is effective that the transmitted light intensities and the scattered light intensities are measured, and the concentration of the specific component in the solution to be detected in a low concentration region is determined from the measured values of the scattered light intensities before and after the mixing of the reagent, and the concentration of the specific component in the solution to be detected in a high concentration region is determined from the measured values of the transmitted light intensities before and after the mixing of the reagent.

**[0008]** Further, in this case, it is effective that the measured values of the transmitted light intensities before and after the mixing of the reagent are compared with the measured values of the scattered light intensities before and after the mixing of the reagent, thereby to detect the occurrence or non-occurrence of a false measurement due to particles suspending in the solution to be detected.

**[0009]** Further, it is effective that at least one of the transmitted light intensities and the scattered light intensities before and after the mixing of the reagent is measured under the same condition for a standard solution with a known concentration and the solution to be detected, and the measured values of the solution to be detected are corrected by the measured values of the standard solution to determine the concentration of the specific component in the solution to be detected.

**[0010]** It is effective that the standard solution is water not containing the specific component.

**[0011]** Further, the present invention also provides a method for measuring a concentration of solution, comprising the steps of: determining a protein concentration of the solution to be detected with the above-described method for measuring a concentration of solution; determining a total optical active substance concentration in the solution to be detected by measuring an optical rotation of the solution to be detected before the mixing of the reagent; and then determining a concentration of an optical active substance other than the protein from the protein concentration and the optical active substance concentration.

**[0012]** Further, the present invention also provides an apparatus for measuring a concentration of solution, comprising a light source for irradiating a solution to be detected with light; a sample cell for holding the solution to be detected such that the light transmits through the solution to be detected; a photosensor 1 for detecting the light transmitted through the solution to be detected and/or a photosensor 2 for detecting the scattered light generated when the light has propagated through the inside of the solution to be detected; a mixer for mixing a reagent, which changes the optical characteristics of only a specific component in the solution to be detected, into the solution to be detected; and a computer for controlling the mixer to analyze an output signal from the photosensor, wherein a concentration of a specific component in the solution to be detected is determined from